Territorial analysis method of socio-economic conflicts between human development and environmental conservation.

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Abstract

This paper focuses on a methodology for analyzing potential territory capacities such as local development and conflict resolution of the use of land natural resources.
Ecological economics and *landscape ecology* are the theoretical origins of this methodology so that it's possible to give a value to both economic aspects and social-environmental aspects.
In this case public stakeholder choices will have many actuation opportunities because they will be based on the sustainable development concept.
The aim of our study is to describe the multifunctional role that the agricultural activities carry out within a territory; to do this, it is necessary to find a methodology which can define social functions that characterize the territory of analysis. According to the definitions widely accepted by part of the European scientific community, the agricultural field expresses four kinds of functions: environmental, natural, social and economic. Among these, the role of the forest is particularly important.
For every defined function a set of indicators has been chosen that permit the analysis of the various aspects of agricultural activities. The statistical basis was the 2000 Agriculture Census (Istat, 2001). In this document there is present different types of information that are connected to the multifunctional aspects of the field.
This paper also analyses potential conflicts between environmental conservation and human development, and starts from the many functions of the agricultural sector in the area called Comprensorio Empolese Val d'Elsa, located in the Region of Tuscany.

1.Introduction

The goal of the work is the study of a basic methodology for the analysis of the potentialities of territory in terms of local development and the solution of conflicts that may originate from the alternative use of natural resources. In order to achieve the objective the work was developed through the following phases. First of all we analysed the theoretical basis of territorial planning, with special

[1] The authors are researchers at the Department of Agricultural and Land Economics, University of Florence. This paper was written under the umbrella of MIUR-PRIN 2004, "La gestione sostenibile delle risorse territoriali: sistemi di supporto alle decisioni", coordinated by Susanna Nocentini. The paper is a result of group collaboration: it is important to emphasize a direct contribution by Roberto Fratini to chapters 2 and 6, Chiara Franciosi to chapters 1 and 5 and Francesco Riccioli to chapters 3 and 4.

attention towards the recent proposals coming from *ecological economics*, regional development theories and *landscape ecology*. The approach that best integrated the principles of these subjects was the geographic multicriterial analysis. Therefore, the methodology was applied to a specific super-municipal territorial reality with the aim of analysing and managing problems linked to grass-root sustainable development compatible with conservation of the environment and the cultural and landscape characteristics of the territory. The area that was selected, the Empolese-Valdelsa district, was considered sufficiently broad and representative of all the problems involved.

2. Theoretical and methodological basis

Within economic theory the concept of territory has various meanings. From the point of view of environmental economics and ecological economics the territory represents the habitat for wild species, the link among hydro geological, climatic and biological systems and the place for important social services such as outdoor recreation. From the perspective of agricultural economics, the territory represents the place for primary productive activities and is characterised by its agronomic and climatic parameters, its position compared to the market, as well as by its quality, typicality and parameters of tradition (Bernetti and Fagarazzi; 2002).

Through this brief overview, it is easy to realise how, due to its complexity and omni-comprehensiveness, the role of the territory, its conceptualisation and the research for normative and interpretative models is considerably changed in the economics theory in the last years.

The turning point in the construction of a new integrated concept of territorial problems is represented by the development of the idea of ecological economics, historically proposed by Costanza and Daily within the *International Association of Ecological Economics*.

The deliberation of possible alternative concepts of development started at the beginning of the seventies, with the analysis of new concepts such as eco-development and the influence of

environmental components of economic growth (Meadows, 1972). Friedman and Waver synthesised such observations in the concept of territorial regional development, that favours strategies based on the activation of factors of endogenous development, aiming at improving the environmental, social and cultural heritage as a source of competitiveness and therefore of economic growth (Friedman and Waver, 1979, Friedman, 1992). The concept of regional development in territorial terms becomes hence an expression of "self-centered" and "grass-root" development processes based on the improvement of natural and social regional resources.

Landscape ecology, derived from the interaction among ecology, geography and territorial planning has produced a methodological approach finalised in integrating, on a territorial basis, concepts typical of ecology and social sciences (Turner, 1998). According to landscape ecology an ecosystem is subject to two main orders of processes:

- Natural causes, such as ecological successions, long term natural phenomena (i.e. sedimentation or erosion) and short-term natural phenomena (natural fires, hurricanes, pests, etc.).
- Human activity that tends to modify landscape and land use through settlements, agricultural and productive activities.

Landscape ecology allows integrating social and economic problems within models of territorial evolution and can therefore be of great practical utility for land use planning, biodiversity conservation or for the management of environmental risks (Van Den Bergh et al., 2001).

The need to treat complex sets of multidimensional indexes as well as the need to adopt a pluralistic and "participative" approach are the two main reasons which led ecological economics to mainly adopt decisional analysis models of environmental problems based on multicriterial techniques. Multicriterial analysis in fact represents the most appropriate family of methodologies useful to tackle problems relative to potential conflicts between self-centred development of productive activities and safeguard of the natural environment and of historical and cultural characteristics of local population. More in

detail, as underlined by (Martinez-Allier, 2002), more than solving all possible conflicts, the multicriterial analysis allows an in-depth study on the nature of the contrast, improving the informational framework and favouring a transparent political negotiation. The main advantage of multicriterial methods lies in fact in the possibility of considering simultaneously a large amount of information and models derived from various subjects (Bernetti, 1993) supplying a backing in not completely structured decisional problems.

3. A methodological proposal

The analysis of environmental conflicts it becomes a fundamental instrument for sustainable land planning, just because by means of this It is possible to compare possible strategies of development and to consider what is the right way to encourage endogenous development of territory. In areas in which territory is an element characterizing the local development, the analysis of conflicts acquires a particular meaning for the conservation and the improvement of this element. In particular in rural areas in which the agricultural and forest element characterize the environmental, social and economic equilibrium, it becomes a priority to choose the right way of development which will permit the improvement and the conservation of territory.

On this subject it is important to emphasize the role of agricultural and forest activities; this sector carries out a variety of functions that can be applied to only economic field but which concern other aspects like environmental and social functions: this characteristic is very rare in other productive sectors. In our research we have individualized, with a view toward sustainable development of territory, typical areas suitable for the production of social functions. The study of social functions becomes the mean instrument to identify conflicts about the use of natural resources.

Important works on environmental conflicts (Schwartz D., Singh A., 1999) have shifted focus from non-renewable resources to renewable resources. The use of renewable resource conflicts can broadly

be categorized under: (1) “direct” or “indirect” conflict; (2) international or intranational conflict. Based on this categorization, a typology was developed with the purpose of achieving two goals: (1) to help researchers and policy-makers better situate themselves in the vast literature in the field of “environment and conflict”, and more generally, “environmental security”; and (2) to establish the framework for a data collection on environmental conflicts which, in turn, will help researchers and policy-makers identify patterns in the linkages between environmental resources and conflict, thereby facilitating conflict resolution and prevention.

To analyze the role that the agricultural field takes, it was necessary to identify mean function expressed by agricultural farms and to evaluate a scale of multifunctionality for the examined territory. In particular, it is possible to analyze socio-economic consequences that can occur due to the change of agricultural cultivation and land use. For this kind of analysis it becomes indispensable to have a wide informative basis, not only macroeconomic variables. We especially need a detailed cartographic database that contains all the local variables. Consequently our database can be defined as a collection of non-redundant computer data organized so that it can be expanded, updated, retrieved and shared for various uses. It is important to underline that a capability of GIS allows the performing an integrated analysis of spatial and attributing data. GIS can be considered as a special purpose digital database in which a common spatial coordinate system is the primary means of storing and accessing data and information. In such a process it is crucial to have the availability of economic, environmental and social geo-referenced data are sufficiently detailed. For these reasons models of multicriterial evaluation and of analysis of conflicts will have to be implemented within a Territorial Information System[2]. Normally the two digital representations of territorial characteristics employed in the Territorial Information Systems are rasters and vectors. Even though both representations can be used,

[2] The need in territorial planning to consider simultaneously a multitude of geo-referenced objectives also derives from other subject and theoretic-methodological approaches that are converging on the same problems (Bernetti, 1993).

in most cases the applications of multicriterial analyses within Territorial Information Systems are based on raster representations.

4. Functions and indexes

After the set definition of indicators, the next step of analysis was focused on their spatial location and the grid resolution definition of the conflict maps.

The database sources was based on the V Agricultural Istat Census (2001), the Corine Land Cover, the documents of protected areas provided by the Region, the map of the water network and the geomorphologic and slope maps.

All indexes (indicator measurement) were gathered in cadastral unit worksheets: each cadastral unit represents the maximum useful details of the analysis. In this way, it was possible to maintain the specific details of Agricultural Istat Census database that were joined with territorial characteristics where each database record represents a cadastral unit.

Thus vector themes were obtained and directly linked to the three functions of cadastral units.

A new spatial database was obtained and connected to the Geographical Information System and cadastral units are joined to specific farms located in them. Section 19 of the Census questionnaire was used for it because it contains geographical references to the farms.

The core of this analysis step is represented by the definition of multifunctional farms; in particular, three main functions have been identified: environmental function, economic function, social function.

The first one is defined by the peculiarities of natural areas and the interaction between human activities and environment, and the analysis of this function was based on three main aspects: type of landscape, presence of bodies of water and human presence.

Eleven indexes are used for defining environmental function analysis: percentage of natural areas within the map-sheet, percentage of urban areas within the map-sheet, Shannon index, fragmentation of

forest areas; percentage of urban, rural and uncultivated areas near a body of water (buffer area 10-40 meters), road density and percentage of wetlands; presence of mono cultivated areas within each cadastral unit; presence of biological cultivations; presence of biological livestock; presence of chemical and organic fertilization; presence of natural protected areas.

A special software "Arcview *ATtILA"* was used for index analysis that represents a powerful tool of ESRI program for territorial aspects analysis.

Some "rules" were used for this purpose, such as *border effect* (LAURANCE e YENSEN, 1991; SCHONEWALD-COX E BUECHNER, 1992) where environmental transformation was directly related to microclimate changes and animal species. The changing entity (DAVIES et al., 2001) depends on the type of areas where fragmentation effect has occurred and also depends on the degree of fragmentation.

Some indexes have been used for human activities analysis such as the presence of urban areas close to a body of water, and they describe fragility of the environment; in fact all human activities near a body of water represent a pollution risk. Also agricultural activities have a direct impact on environment: presence of livestock, chemical fertilization or mono-cultivated areas have been directly related to the presence of polluted substances in water and to biodiversity diseases.

The economic function was defined by the production of food or other goods (such as energy, biomass supplies, pharmaceutical products, etc.)

Two specific economic indexes are used in the analysis: presence of cadastral unit fragmentation, presence of model farms. These indexes underline farm efficiency and potential territorial transformation. The meaning of social function can be closely related to landscape conservation, maintenance of local tradition and territorial preservation. In this case indexes used for analysis are: presence of recreational areas, presence of multifunctional areas, presence of planned forest areas, presence of direct selling farms, presence of farms that use forest products for energy purposes.

5. Multicriteria Aggregative process

The next step of the research was focused on the multicriteria aggregative process of all indexes, using "Fuzzy Yanger algorithm" (1.1). The aggregation of indexes represent the functions' value.

$$A_j = \frac{ind_1 + ind_n}{n} \cdot C + \min(ind_1; ind_n) \cdot (1 - C) \qquad (1.1)$$

where

A_j= j^{th} alternative

ind_n = index value of n^{th} function

C = Fuzzy Yanger operator value

It is important to underline the range that Fuzzy Yanger Operator (C) can assume: it represents the Stakeholders' choices, in fact they can give a number close to 0 to lower importance functions (alternatives) or they can give a number close to 1 to higher importance functions (alternatives). The best alternative is represented by the higher function values. Each farm is represented by different levels of environmental, economic, social functions, where each cadastral unit is represented by a variable number of farms: the aggregative process of the three functions represents the multifunctional level of study areas that it shows in figure 1 (darker colors are higher multifunctional level values).

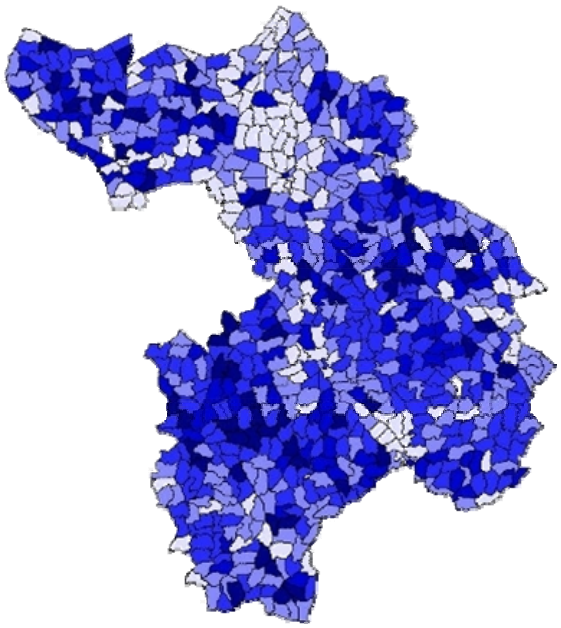

Figure 1 Multifunctional farms

6. Conclusion

The paper focuses on a methodology for analyzing potential territory capacities such as local development and conflict resolution of the use of land natural resources where multifunctional areas have been considered the link between human activities and environmental resources, and they are very important for correct territorial planning. Ecological economics and landscape ecology are the theoretical origins of this method that combine MultiCriteria Decision Analysis and Geographical Information System. Three main functions of multifunctional farms were defined. Environmental, economic and social function were analyzed according to a set of indexes: thus, they were combined with multicriteria rules (Fuzzy Yanger Algorithm). Subsequently, multifunctional values of farms were produced from this aggregative process: the best alternatives are represented by the higher values (darker colors in figure 1).

Higher levels of environmental function are located on the north side of our study area: the municipality of Cerreto Guidi and the municipalities of Certaldo, Montaione and Montelupo

Fiorentino. The higher levels of economic function are present in the north-east side of area. Multifunctional farms are located on the north side of the municipality of Montaione and the north-west side of Gambassi terme, on the south side of Montelupo Fiorentino and Montespertoli and on the north side of Fucecchio (figure 1).

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